DESCRIPTION

Adjustable Bed Mattress

Technical Field

The present invention relates to a mattress designed to be laid on an adjustable bed used for nursing care.

Background Art

In order to prevent the occurrence of decubitus ulcers, more commonly known as bedsores, adjustable beds used as turning beds and the like operate to assist postural change of care recipients. The postural change is generally achieved by inclining a part, or the entire mattress of the beds on which care recipients are lying so as to turn the care recipients in the direction of inclination (refer to Japanese Laid-Open Patent Application Publication No. H06-14824). The majority of these types of beds employ a mechanism that tilts the mattress surface from a flat position across the width direction of the mattress in order to assist the postural change.

However, when such an adjustable bed operates, it is sometimes the case that a mattress laid on the bed is displaced, and thereby the care recipient on the mattress may be shifted from the proper position. This causes an interruption to the normal operations of adjustable beds. Such a problem also leaves room

for improvement in terms of safety for the care recipients.

Disclosure of the Invention

In order to solve the problem described above, the present invention is a mattress to be laid on a platform of an adjustable bed having a transformable bed surface. Here, a fixture that engages with the platform to secure the mattress is disposed on a surface of the mattress facing the platform.

This structure prevents displacement of the mattress from the bed surface, which may occur when the adjustable bed is driven. Consequently, a care recipient in a recumbent position on the bed is able to safely start the postural change from the proper position. In addition, a good, sound sleep is guaranteed by this structure.

To be more specific, with the mattress of the present invention, a mesh may be formed on a front face of the platform, and the fixture secures the mattress by tightly fitting into one or more interstices of the mesh.

Here, the fixture may be detachable from the platform. This structure is desirable since it facilitates the mattress replacement and the maintenance of the adjustable bed.

The fixture may be disposed, on the surface of the mattress, in a part of the mattress corresponding to a lower back region of a user lying on the mattress. This structure is desirable since it facilitates stretching the mattress when the adjustable bed is driven.

An example of adjustable beds applying the present invention includes: the platform of which the front face is flexible; a flex mechanism operable to flex the platform to form a flexion position that includes at least one of a sitting-up position and a knee break; and a tilt mechanism operable to tilt the front face laterally. Here, both the flex mechanism and the tilt mechanism are operable with the other mechanism in operating condition.

Brief Description of the Drawings

FIG.1 is a perspective view of an adjustable bed in a first embodiment;

FIGs. 2A-2C are partial cross-sectional views in a vicinity of a bed frame and an adjustable stage;

FIG. 3 is a schematic plan view of the adjustable bed;

FIG. 4 is a perspective view showing a structure of a fixed stage;

FIG. 5 is a perspective view of the adjustable bed (with the left-side members raised);

FIG. 6 is a perspective view of the adjustable bed (in a flexion position);

FIG. 7 is a perspective view of the adjustable bed (tilted laterally to the left);

FIGs. 8A-8D are longitudinal schematic views of the adjustable bed and the bed frame;

FIG. 9 is a structure diagram illustrating the adjustable

bed having a meshed surface and a mattress having a fixture;

FIG. 10A shows a structure of the mattress fixture and FIGs. 10B-10C are diagrams illustrating a behavior of the mattress when the adjustable bed is driven;

FIGs. 11A and 11B are perspective views of a variation of the adjustable bed; and

FIGs. 12A-12F are perspective views of another variation of the adjustable bed.

Best Mode for Carrying Out the Invention

1. First Embodiment

1.1 Structure of Adjustable bed

FIG. 1 is a perspective view illustrating a structure of an adjustable bed 2 according to a first embodiment of the present invention.

The adjustable bed 2 is constituted such that a bed frame 10 is disposed on an adjustable stage 20 placed on a fixed stage 30.

The bed frame 10 includes a coupled platform 11a-11d, which is formed by dividing a surface part (i.e. upper surface of the bed) into four sections corresponding to the back, hip, upper-leg, and lower-leg regions of a care recipient's body lying on the bed, and coupling these sections together so as to be freely adjustable. In the coupled platform 11a-11d, an upper-body member 11a, a lower-back member 11b, an upper-leg member 11c, and a lower-leg

member 11d are each coupled in the given order.

The lower-back member 11b is fixed directly onto the adjustable stage 20 by welding, for example, thus preventing the bed frame 10 from being disengaged from the adjustable stage 20. Side members 12Ra-12Rd and 12La-12Ld for supporting the care recipient's body from the sides are coupled to the platform 11a-11d on the right and left, respectively. The upper-body member 11a and upper-leg member 11c of the bed frame 10 are respectively coupled, via L-shaped couplers 211 and 212, to the shafts of direct-acting actuators M1 and M2 (see Fig. 3 showing a plan view of the bed) disposed on a center beam 21A of the adjustable stage 20. Herewith, the actuators M1 and M2 are able to transform the bed frame 10 so that the care recipient is placed in a flexion position (see FIG. 6 showing a bed form; FIG. 8B showing a side view of the bed).

A wire mesh is in fact placed over the surface of the coupled platform 11a-11d and side members 12Ra-12Rd and 12La-12Ld of the bed frame 10. However, here, this wire mesh has been omitted from the drawing as well as the following drawings in order to illustrate the structure of the bed with clarity. Consequently, these drawings depict only the frames of the coupled platform 11a-11d and side members 12Rd-12Rd and 12La-12Ld. In the present invention, however, the coupled platform and side members are not confined to having the wire-mesh surface construction, and may alternatively be composed of coupled pieces of a board material. In FIGs. 5 to 7 showing bed operations, certain parts of the structure, such as

side-member support frames 24R and 24L, have been omitted so as to illustrate the operations with clarity.

Among the side members 12Ra-12Rd/12La-12Ld, the side members 12Rc/12Lc corresponding to the upper-leg region of a care recipient's body have box-shaped pockets with hollow space of approximately the same dimensions as the side members 12Rc/12Lc (see FIG. 8D showing a side view of the bed). Fan-shaped members 13R/13L (13R not shown) are coupled to the edges of the side members 12Rd/12Ld corresponding to the care recipient's lower-leg region. These members are normally housed in the pockets of the side members 12Rc/12Lc, respectively. Then, when the bed frame 10 is transformed into a flexion position, the fan-shaped members 13R and 13L come out of the pockets to support the care recipient's knee region.

The adjustable stage 20 has a rectangular frame construction composed of the center beam 21A, side beams 21R and 21L, and two parallel end bars connected to either end of the center beam 21A and side beams 21R and 21L. On the side beams 21R and 21L, rollers 200, 201, 202, and 203 (the roller 203 not shown in FIG. 1, being behind the bed frame 10) are disposed so as to slide in a *y* direction on roller slide bars 300 of the fixed stage 30, as indicated in FIG. 1.

Ladder-shaped side-member support frames 24R/24L are respectively disposed on the side beams 21R/21L of the adjustable stage 20. Each of the ladder-shaped side-member support frames

24R and 24L is composed of two bars 22R/22L and 23R/23L that run in the same direction as the side beam 21R/21L, and two connecting bars 231R/231L and 232R /232L. The bars 23R and 23L have concave sections in the area where the side-member support frames 24R/24L meet the side members 12Rb/12Lb, so that the side members 12Rb/12Lb fit in the space provided by the concave sections (see FIG. 3 showing a plan view of the bed). Thus, the adjustable stage 20 is designed in such a way that the side members 12Rb/12Lb will not interfere, in a thickness direction of the bed, with the side members 12Ra/12La and the side members 12Rc/12Lc on either side of the side members 12Rb/12Lb, when the bed frame 10 is transformed into the flexion position. The bars 22R/22L are coupled respectively to the side beams 21R/21L by couplers 236Ra/236La and 236Rb/236Lb, allowing the bars 22R/22L to rotate freely through an axial direction while remaining secured to the side beams 21R/21L. When the side-member support frames 24R/24L are rotated on the axis of the rotating bars 22R/22L to a position perpendicular to the horizontal bed surface (i.e. so as to point in a *z* direction), the side members 12Ra-12Rd/12La-12Ld of the bed frame 10 are pushed up, thus enabling the right/left sides of the bed frame 10 to be raised.

Here, FIGs. 2A-2C are schematic sectional views of the bed showing the operation of actuators in the vicinity of the adjustable stage 20 and the upper-leg member 11c of the bed frame 10. In addition to the actuators M1 and M2 used for transforming the bed frame 10, direct-acting actuators M3R and M3L are symmetrically

disposed on the adjustable stage 20 to the left and right of the center beam 21A (i.e. in the *y* direction toward the coupling members 236Ra and 236La, respectively). The tips of shafts of the actuators M3R/M3L are coupled to L-shaped members 235R/235L fixed directly below the rotating bars 22R/22L. According to this structure, the shafts of the actuators M3R/M3L extend, and thereby the L-shaped members 235R/235L and bars 23R/23L are rotated on the axis of the rotating bars 22R/22L. Then, the side-member support frames 24R/24L are raised from the horizontal plane to a position perpendicular to the horizontal bed surface (FIGs. 2A → 2B → 2C).

Stage bars 27R/27L are provided on the underside of the side beams 21R/21L, and tightly fitted into stage-bar bearings 36R/36L (U-shaped cross-sectional) located to the side of the fixed stage 30. Within these stage-bar bearings 36R and 36L, reverse L-shaped tabs are aligned in a width direction of the bed. These tabs hook around the stage bars 27R and 27L, and thereby the adjustable stage 20 is secured in a vertical direction. When the adjustable stage 20 is tilted, the stage bar (i.e. either 27R or 27L) on the raised side is separated from the corresponding stage-bar bearing (i.e. 36R or 36L).

FIG. 4 is a perspective view illustrating a structure of the fixed stage 30. The fixed stage 30 includes a rectangular frame 31. A pair of shorter ends of the frame 31 forms the roller slide bars 300 so that the rollers 200-203 of the adjustable stage 20 travel back and forth on them. Side beams 32R and 32L of the fixed

stage 30 are slide-slot members (square-bracket cross-sectional), and are disposed such that the slide slots face one another. Into the side beams 32R/32L, the ends of support arms 354R/354L and 356R/356L coupled respectively to the stage-bar bearings 36R/36L are tightly fitted so as to freely travel back and forth. Reverse L-shaped rotating arms 351R/351L and 352R/352L coupled at one end to the side beams 32R/32L are linked to the support arms 354R/354L and 356R/356L, and horizontal links 353R/353L are coupled to the rotating arms 351R/351L and 352R/352L. Between the stage-bar bearings 36R/36L and the horizontal links 353R/353L, actuators M4R/M4L are respectively disposed at an angle. Herewith, parallelogram mechanisms 35R/35L, which are based on horizontal slide mechanisms, are formed on the right and left sides of the fixed stage 30. With these parallelogram mechanisms 35R/35L, the rotating arms 351R/351L and 352R/352L move in a circular motion centering on the points at which they are coupled to the side beams 32R/32L. One ends of the support arms 354R/354L and 356R/356L travel back and forth on the inside of the side beams 32R/32L, while being regulated by the rotating arms 351R/351L and 352R/352L. The support arms 354R/354L and 356R/356L oscillate in a vertical direction, and thereby the adjustable stage 20, supported by the stage-bar bearings 36R and 36L, and the bed frame 10 are able to move vertically up and down from either or both the right and left sides of the fixed stage 30. Therefore, the adjustable bed 2 can be elevated even in a small space as a consequence of space saving,

while the use of the rollers 200-203 and the parallelogram mechanisms 35R and 35L realizes space saving even during postural change operations. By driving one of parallelogram mechanisms 35R and 35L corresponding respectively to the side beams 32R and 32L, postural change from the supine to lateral position is achieved. On the other hand, a height adjustment (high/low) mechanism of the bed is realized when the parallelogram mechanisms 35R and 35L are driven simultaneously.

Note that the operations of the actuators M1, M2, M3R, and M3L are respectively controlled by a motor driver and a CPU in a control unit (not shown). This allows the caregiver to use, for example, a controller in hand to execute drive settings such as manual/automatic setting and program setting. In addition, the provision of a cord-attached cable remote control or an infrared wireless remote control enables settings to be performed by the care recipient.

1.2 Operation of Adjustable bed (Postural Change from Supine to Left Lateral)

An adjustable bed having the above structure is used with a mattress placed on the bed frame 10. In a normal configuration, the coupled platform 11a-11d and side members 12Ra-12Rd and 12La-12Ld are set to be substantially horizontal as shown in FIG. 1.

When a user (here, for example, a caregiver) selects, from a menu, an item relating, for example, to "postural change from

the supine to left-lateral position, in flexion position" via the controller and has this selection executed, firstly the actuator M3L attached to the adjustable stage 20 is operated to extend its shaft outward. The L-shape 235L coupled to the tip of the shaft, and the bar 23L rotate on the axis of the rotating bar 22L, and the side-member support frame 24L rises from the horizontal position to a position vertical to the horizontal plane of the bed (FIGs. 2A → 2B → 2C showing actuator operations; FIG. 5 showing side members 12La-12Ld in a vertically raised state; and FIG. 8C showing a side view of the bed in this state).

Next, the tips of shafts of the direct-acting actuators M1 and M2 attached to the center beam 21A of the adjustable stage 20 extend out, pushing up the upper-body member 11a and upper-leg member 11c of the bed frame 10 from the underneath via the L-shaped couplers 211 and 212 to place the care recipient in a flexion position with the upper body raised and the knees bent (FIG. 6 showing a perspective view of the bed in the flexion position; and FIGs. 8A → 8B showing side views of the bed transforming into this state). The side members 12La-12Ld also transform in conjunction with the coupled platform 11a-11d. At this point, the fun-shaped member 13L comes out from the pocket provided in the side member 12Lc to support part of the mattress and a bedding mattress around the care recipient's knee region (FIGs. 8C → 8D showing side views of the bed transforming into this state).

When the flexion position with the left side members raised

is achieved according to the above operations, the actuator M4R on the right side of the fixed stage 30 operates to extend its shaft outward. As a result, the stage-bar bearing 36R and the horizontal link 353R separate from one another at an angle, the support arms 354R and 356R slide along the slide slot of the side beam 32R and rise up, and the parallelogram mechanism 35R operates. At this point, the support arms 354R and 356R (or 354L and 356L) raise the right side of the adjustable stage 20 vertically upwards as a result of the circular movement of the rotating arms 351R and 352R (or 351L and 352L). At the same time, the right side of the adjustable stage 20 is raised to a higher position than the fixed stage 30, the roller 200-203 of the adjustable stage 20 roll on the roller slide bars 300, and the bed frame 10 tilts toward the side beam 32L of the fixed stage 30, i.e., toward the left side of the bed (FIG. 7 showing a perspective view of the bed being tilted). Here, a desirable tilt angle is in the range of, for example, approximately 30 degrees to 70 degrees from the horizontal, one example being a tilt angle of 50 degrees.

According to the above transformations of the bed frame 10, the posture of the care recipient is changed smoothly from the supine to the lateral position while the body of the care recipient being supported by the coupled platform 11a-11d and the side members 12La-12Ld after firstly placed in a supine flexion position with the upper body raised and knees bent. Well-supported postural change that is similar to when a care recipient is turned by the

guiding hand of a caregiver is thus achieved.

According to the first embodiment, postural change of the care recipient is performed in a flexion position, which imposes the least burden on the care recipient. As a result, the care recipient is able to comfortably take an approach to postural change. Thus, it is promising that the conventional physical discomfort and psychological anxiety associated with postural changes will ease. Furthermore, according to the first embodiment, the caregiver is not required to perform physically hard working, manual procedures when changing the posture of the care recipient. Therefore, it is possible for even a caregiver with little experience to correctly perform postural change. By using the adjustable bed 2 of the first embodiment, the caregiver is thus better able to focus on providing compassionate and attentive care.

1.3 Adjustable Bed Mattress (having a fixture) of the Present Invention

Here, an adjustable bed mattress 1 of the present invention is described in detail. FIG. 9 shows an exemplary structure of the adjustable bed 2 and an adjustable bed mattress used for the bed. The adjustable bed mattress 1 has a fixture 100 to be attached to the lower-back member 11b of the adjustable bed 2 corresponding to the hip region of a care recipient's body, as shown in FIG. 9.

As shown in FIG. 10A, the fixture 100 has a structure in which a total of four project portions 102, each having a T-shaped cross-sectional construction, are disposed on a plate 101. The

project portions 102 are made of hard rubber, and tightly fitted into the interstices of the wire mesh covering the surface of the lower-back member 11b of the adjustable bed 2 to fix the mattress onto the bed.

According to the mattress 1 having the fixture 100, when the bed is driven and transformed into Gatch position (FIGs. 10B → 10C), the head and foot sides of the mattress 1 smoothly stretch while the mattress 1 is well secured around the fixture 100 as shown in FIG. 10C. Herewith, the occurrence of displacement of the mattress 1 (in the thrust direction) due to the adjustable bed operations can be effectively prevented while a smooth mattress surface can be obtained due to the effect of the mattress stretches. Note that the project portions 102 are detachable from the wire-mesh surface, which facilitates the replacement of the mattress 1 and the maintenance of the adjustable bed 2.

In the case where the mattress 1 has relatively less stretches, the fixture 100 may be disposed on a part of the mattress 1 other than the part facing the lower-back member 11b. Thus, a location for setting the fixture 100 is not confined to the above, and furthermore multiple fixtures may be provided.

In addition, the fixture is not restricted to one having the above structure, and may alternatively have another structure (e.g. use of a hook and loop fastener on a section of the platform having a flat surface) according to materials and a structure of the platform.

1.4 Related Matters

In the example given in the first embodiment above, the bed employs a structure that uses the parallelogram mechanisms. However, use of the adjustable bed mattress of the present invention is not limited to a bed having such a structure, and it is possible to apply the present invention also to adjustable beds having the following structures.

An adjustable bed shown in FIG. 11A has a structure in which direct-acting actuators are disposed vertically, and a set of side members on the left or right is moved vertically up and down using a elevating mechanism. Herewith, the platform placed on an adjustable stage is tilted. With this adjustable bed, a pair of columnar direct-acting actuators is disposed within a rectangular fixed stage, and a bed frame supported by the adjustable stage is positioned on top of the actuators. The platform, as in the first embodiment, is constructed as a coupled platform, which is formed by coupling together a plurality of sections corresponding to the care recipient's upper-body, hip, upper-leg, and lower-leg regions. Among these, the section corresponding to the hip region is secured to the adjustable stage having a frame construction. Provided on the underside of the platform is a drive unit that includes an actuator mechanism for forming a flexion position.

The sets of side members are disposed on the columnar direct-acting actuators. Inside the side members, housing slots are formed. Here, housed in the housing slots are pullout walls,

each of which formed by partitioning a panel into sections along a longitudinal direction of the bed and coupling these sections with one another. The side members are coupled to the adjustable stage supporting the platform via the pullout walls. The pullout walls are biased to a width direction of the housing slots by tension springs or the like, and are automatically housed in the housing slots when a force pulling the pullout wall out of the housing slots weakens.

According to an adjustable bed having the above structure, when the bed is driven, a flexion position is firstly formed with the coupled platform, as shown in FIG. 11B. Subsequently, one of the columnar direct-acting actuators operates to lower a set of the side members positioned thereabove. In accordance with this operation, the adjustable stage is tilted, which brings the coupled platform down at an angle. At the lower side of the tilted adjustable stage, the pullout wall is pulled toward the coupled platform from the corresponding housing slot in a manner that the pullout wall is raised relative to the coupled platform. That is, the pullout wall at the lower side hangs from the coupled platform with the angle between the two narrowed. At the same time, the side members are placed in a raised state relative to the coupled platform. This achieves the effect of supporting the side of the care recipient's body with the pullout wall while keeping the care recipient in the flexion position. Thereby, postural change is performed in a favorable manner, as in the first embodiment.

FIGs. 12A-12F illustrate a structure of another adjustable bed.

The structure of this adjustable bed can be adopted by general-purpose beds. The adjustable bed is constituted by laying an air mattress formed from a plurality of airbags on a general-purpose bed. A characteristic of this adjustable bed is the use of an air pump to supply/discharge air independently for each airbag via an air hose. The air hose has a valve whose opening/closing motions, along with the air pump, are controlled by a control unit (not depicted), and thus, the inflation/deflation of respective airbags are individually controlled. The airbags are, as one example, partitioned into an upper body and hip portion (double layer), an upper and lower leg portion, and portions for right and left sides of the bed according to the joints of a care recipient's body.

An adjustable bed having the above structure is normally used with a bedding mattress or the like placed over the air mattress. When postural change of the care recipient from the supine to the lateral position is carried out, the airbags on both sides of the bed are firstly inflated (FIGs. 12A → 12B). Next, the care recipient is placed in a flexion position by tilting the airbag of upper body and hip portion in a longitudinal direction, and inflating the airbag of upper and lower leg portion so as to form a knee break (FIGs. 12C and 12D). It is then possible to turn the care recipient to be in either the left or right lateral position,

while maintaining the flexion position, by deflating the airbag on either the left or right side and inflating the lower of the double layer airbags of upper body and hip portion (FIGs. 12E and 12F).

Here shows an example using a general-purpose bed. However, the adjustable bed having the above structure has an advantage in portability, and therefore the bed can, in addition to being applied to a variety of general-purpose beds, also be laid directly on the floor (i.e. directly over tatami mats, carpet, or the like).

Industrial Applicability

An adjustable bed mattress according to the present invention can be used as a mattress used for a nursing care bed or a reclining bed.